Recrystallization of single crystal 6,13-Bis(triisopropylsilylethynyl) pentacene within liquid crystal

Hyun-Bae Park*, Hyo-Taek Jang, Jae-Hoon Kim*,**, and Chang-Jae- Yu*,****

*Department of Information Display Engineering, Hanyang University, Seoul 133-791, Korea

**Department of Electronics and Computer Engineering, Hanyang University, Seoul 133-791, Korea

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ABSTRACT

We investigate the recrystallization of 6,13-Bis(triisopropylsilylethynyl) (TIPS) pentacene within liquid crystal. Single crystalline structure of the TIPS pentacene was grown up to a few hundred micro-meters within liquid crystal as a solvent. The large anisotropy of the single crystalline TIPS pentacene flake also was observed.

1. INTRODUCTION

A solution processible organic thin film transistors (OTFTs) based on conductive π-conjugated molecules, especially 6,13-Bis(triisopropylsilylethynyl) (TIPS) pentacene have received lots of interest due to its potential of large area, low-cost fabrication and flexible displays [1-5]. But still the charge carrier mobility of TIPS pentacene TFT must be improved. It is well known that mobility of the TFT is highly dependent on the degree of molecular ordering and direction of the ordering [6-8]. Therefore several ways have been reported to improve the TFT properties by using different solvent [9], air flow [10] and temperature gradient [11]. We have recrystallized large size single crystal TIPS pentacene using liquid crystal materials named 4-cyano-4'-pentylbiphenyl (5CB) as solvent.

2. EXPERIMENTS

A glass substrate was cleaned in an ultra-sonic bath with acetone, isopropyl alcohol (IPA), and deionized water. After that substrates were blown with nitrogen and were heated on the hot plate to eliminate the residue.

We prepared 15 wt% TIPS pentacene solutions composed of liquid crystal (5DB), which was used as solvents. That was coated on the cleaned substrate by bar-coating method as described in Fig 1.

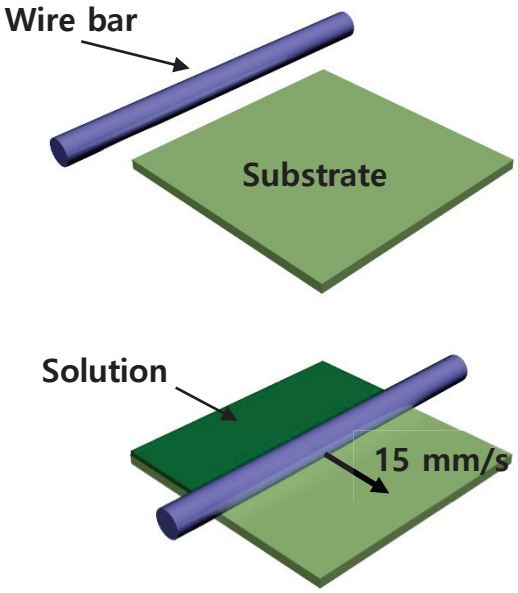

Fig 1. Schematic diagrams of bar-coating method.

After coating, the substrate was heated at 60 °C for 20 minutes for crystallizing the TIPS pentacene. And then we evaporated liquid crystalline in a vacuum chamber. Pressure of the vacuum chamber was 5 x 10^{-5} torr. Samples were kept in the vacuum chamber for several hours.

3. RESULTS

We examined the substrate with polarized optical microscopy. As you can see in the Fig 2 (a) the size of the TIPS pentacene crystal was several micro-meters before the substrate was heated. But after heating the substrate TIPS pentacene at 60 °C for 20 minutes the size of the crystal became several hundred micro meters as in Fig 2. (b). Also the numbers of crystal has been reduced owing to recrystallization.

When the optic axis of the crystal is aligned parallel to the polarizer it shows fully dark. But when the angle between the optic axis and the polarizer is 45 ° it shows

fully white meaning that recrystallized TIPS pentacene has birefringence and is single crystal. Fig 2. (c) and (d) the image is black except for crystal of TIPS pentacene because the liquid crystal is evaporated by vacuum.

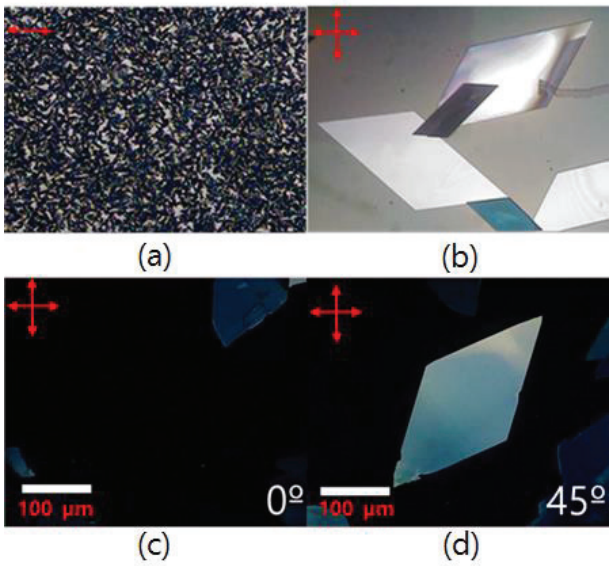

Fig 2. Polarized optical microscopic texture of TIPS pentacene after (a) bar coating and (b) after curing at 60 °C , (c) and (d) are imagess of recrystallized TIPS pentacene after evaporating solvent.

4. CONCLUSION

We demonstrated several hundreds of micro meter size single crystal TIPS pentacene. The size of the crystal is big enough to use as the channel layer with one single crystal. It is expected that if we use this single crystal TIPS pentacene the characteristic of organic TFT will be incredibly increased owing to single crystal structure.

5. ACKNOWLEDGEMENT

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